3-28-2014

# Land Usage near Waterways Affects Nutrient Content: A Study of Algal Communities

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# Land Usage Near Waterways Affects Nutrient Runoff: A Study of Algal Communities

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## Introduction

The way we choose to use land near waterways impacts aquatic communites downstream. Farming and lawn fertilizing can cause water runoff containing nutrients like nitrogen, phosphorus, and potassium. Natural ecosystems may help to both slow runoff and absorb these artifical nutrients before they reach streams and rivers.

Green algae, single-celled photosynthetic organisms, live naturally in these waterways and use nutrients to survive and reproduce. Green algae are both the base of the aquatic food chain and a good indicator of the nutrient content of a waterway.

### Objectives

1) Compare algal communities in Northeastern Indiana streams related to channel size and land use, and
2) Test the hypothesis that neighboring land use types influence algal diversity and abundance

## Methods

12 waterways were sorted into small (up to 8 m wide; n=5), medium (8 to 20 m; n=4), and large (over 20 m; n=3) sizes.

40 mL water samples were taken monthly from May to August, 2013

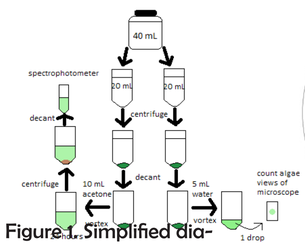



Figure 1. Simplified diagram of algal chlorophyll a extraction and count.

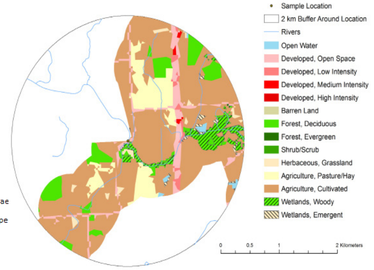



Figure 2. Example of landuse buffer and upstream of sample location.

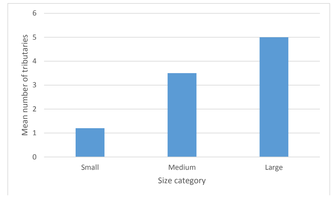
Algal density was measured in ppm of chlorophyll a and algae morphospecies was recorded along with the count (figure 1).

Land usage was categorized in a .5 km buffer zone 2 km upstream of the sample location (figure 2). These proportions were compared with algal abundance.

## Methods, continued

The total number of tributaries in the 2-km buffer zone was recorded for each of the 12 sample sites.

An ANOVA test revealed that large waterways had significantly more tributaries than medium or small streams (p=0.044).




## Results

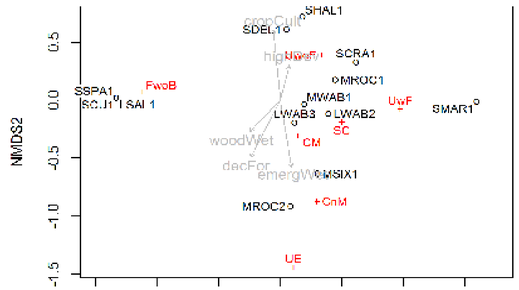



Figure 3. Non-metric multidemensional scaling (NMDS) of streams by algal richness (O) and morphospecies abundance (+) with joint vectors of land use.

A higher proportion of wetlands decreased algal biomass.

A higher proportion of developed land increased algal diversity.

Table 1. Summary of multiple regression equations describing the relationship between algal biomass, species richness, and land usage.

| Model | F | d.f. | p | $R^2$ |
|---|---|---|---|---|
| Chlorophyll a | 176.78 | 8,4 | <0.001 | 0.99 |
| Richness | 5.64 | 5,7 | 0.021 | 0.80 |

## Discussion

The effect of wetlands on algal biomass may be explained both through absorbtion of nutrient runoff from agricultural land and because wetlands are rarely fertilized. These actions would decrease the concentration of N, P, and K for the algae to use, thus inhibiting excessive algal growth.

Developed land likely had the opposite effect, increasing dissolved nutrient content. Paved surfaces are less effective than forest or wetlands at catching runoff. Lawns on developed land are often fertilized and the runoff from over-fertilized lawns likely contributes to a higher nutrient content. The result of these two factors is higher algal diversity. When resources are more abundant, competition allows more morphospecies of algae to coexist.

These results highlight the importance of responsible land management near waterways to the health of aquatic communities. When algal communities become too prolific as a result of artificially high nutrient content, the aerobic process of decomposition uses up dissolved oxygen. This process, called eutrophication, leads to oxygen depleted zones where rivers empty into the ocean.

Figure 4. A photo of Six Mile Ditch, one of the medium size sample sites. Photo taken August 2013.

## Acknowledgements

Thanks to my advisor Dr. Jordan Marshall for supervising data collection and helping to interpret the results